INDEX

Amino acids, prebiotic synthesis, 91–94
Asymmetric forms, stochastic models of synthesis, 201–204
Asynchronous logical description, comprising feedback loops, 252–266
  conditions of various sequences, 259–264
  equations, 255–256
  final states, 264–266
  graph and sequences of states, 258–259
  involvement of time, 252–253
  state tables, 256–257
  variables and functions used, 253–255
Atmosphere, chemical evolution, 79–84
  pollution, 80–84
  trends, 80
  variability, 79–80
Atmospheric chemistry, 63–78
  action of minor constituents, 67–71
  hydrogen and mesopheric chemistry, 71–72
  introduction, 63
  pure oxygen atmosphere, 64–67
  solar radiation absorption, 64
  stratospheric chemistry:
    halogen compounds, 73–74
    oxygen and nitrogen compounds, 72–73
  troposphere, hydrogen, nitrogen, and halogen compounds, 74–76

Belousov-Zhabotinskii reaction, 50–54, 190, 197
  "buffered," 206–211
    Field-Noyes model, 206–207
    homogeneous bifurcations and nonequilibrium phase transitions, 207–209
    transitions in closed BZ reaction, 210–211
    transitions between QHO and RO, 209–210
  complex periodic and nonperiodic behavior, 205–217
    "buffered," 206–211
    discussion, 215–216
    introduction, 205–206
    open system, 211–215
  experimental arrangement, 51
  introduction, 205–206
  mixed mode oscillations, 53
  open system, 211–215
    bursts of oscillations, 211–212
    mixed mode oscillations, 212–214
    period-doubling bifurcations, 214–215
    simple model, 211
  oscillations and corresponding power spectrum, 52–53
  schematic representation, nonequilibrium behavior, 55
Bifurcations:
  complex systems and, 177–199
    adaptive chemistry, 197
    chiral forms, 191–197
    global bifurcations, 183–186
    introduction, 177
    local phenomenon, 179–181
    primary equations, 178–179
    physicochemical examples, 186–191
    primary equations, 178–179
  insect morphogenesis, 219–245
    analysis of reaction-diffusion systems, 239–242
    discussion, 238–239
    dynamical model, 226–234
    epigenetic code, 234–238
    introduction, 219–226
Bromine, atmospheric chemistry, 74
"Buffered" Belousov-Zhabotinskii reaction, 206–211
  Field-Noyes model, 206–207
  homogeneous bifurcations and nonequilibrium phase transitions, 207–209
  transitions in closed BZ reaction, 210–211
  transitions between QHO and RO, 209–210
Buffering, *see* Thermodynamic buffering

Carbonaceous chondrites, organic compounds, 99–100
Carbon tetrachloride, 76–77
Chemical evolution:
  atmosphere, 63–84
    chemistry, 63–78
    observational aspects, 79–84
  asymmetric forms, stochastic modes of synthesis, 201–204
  Belousov-Zhabotinskii (BZ) reaction, 205–217
  bifurcations:
    complex systems, 177–199
    insect morphogenesis, 219–245
  complex biological oscillator, 171–176
  feedback loops, 247–282
  glycolysis, 169
  molecular level, 119–137
  nonequilibrium thermodynamics, 43–62
  optical activity, 109
  optimization of mitochondrial energy conversions, 141–167
  prebiotic origin of photosynthesis, 113–118
  prebiotic synthesis, 85–107
  selection of chirality, 111
  Solvay Conferences, 1–42
    in chemistry, 37–42
    in physics, 7–35
Chemical evolution, nonequilibrium thermodynamics, 43–62
  dissipative structures, 46–54
  introduction, 43–46
  sensitivity and selection, 54–58
  stochastic aspects, 58–60
  summary, 60–61
Chinese crab *(Eriocheir sinensis)*, 172
Chirality, 111
  spatiotemporal patterns, 189–190
Closed BZ reaction, transitions in, 210–211
Complex biological oscillator, 171–176
  spatial correlation, 175
  summary, 176
Complex periodic and nonperiodic behavior, BZ reaction, 205–217
Complex systems, bifurcations and, 177–199
  adaptive chemistry, 197
  chiral forms, 191–197
  global bifurcations, 183–186
  introduction, 177
  local phenomenon, 179–181
  primary equations, 178–179
  physicochemical examples, 186–191
    chaotic behavior, 190–191
    chirality and spatiotemporal patterns, 189–190
    polarity and spatial patterns, 187–189
    sustained oscillations, 187
  primary equations, 178–179
Codimension two bifurcations, 184
Conductance matching of oxidative phosphorylation, 145–146

Degree of coupling, oxidative phosphorylation, 146–150
Dichlorodifluoromethane, 76

Energy sources, prebiotic synthesis, 89–91

Feedback loops, 247–282
  asynchronous logical description and treatment, 252–266
    conditions of various sequences, 259–264
    equations, 255–256
    final states, 264–266
    graph and sequences of states, 258–259
    involvement of time, 252–253
    state tables, 256–257
    variables and functions used, 253–255
  discussion, 278–280
  regulation in biological systems, 248–252
    continuous and discontinuous descriptions, 249–250
    feedback loops, 250–252
    homeostatic or epigenetic, 248
    type of systems treated, 250
  relations with other descriptions, 267–278
    discrete and continuous, 267–270
    methodology applied to chemical systems, 272–274
    numerical and logical iterations, 270–272
    synthetic (inductive) mode, 274–278

Global bifurcations, 183–186
Global nitrous oxide budget, 76
Glycolysis, regulation of dissipation of resonance response (and phase control), 169

Halocarbons, production and dispersion (1973), 77
Homogeneous bifurcations, nonequilibrium phase transitions and, 207–209
Hydrogen, mesopheric chemistry and, 71–72

Imperfection theory, singular perturbation, 181–183
Insect morphogenesis bifurcations, 219–245
Interstellar molecules, 100–101

Melting of primitive earth, 86–87
Mesospheric chemistry, molecular hydrogen, 71–72
Methyl chloride, sources of, 76
Mitochondrial energy conversions, optimization of, 141–167
  degree of coupling, 146–150
  introduction, 141–146
  nonlinear energy converter, 159–166
  thermodynamic buffering, 150–158
Molecular level, evolution of life, 119–137
  biological complexity, 119–120
  by natural law, 128–131
  in nature, 131–136
  reproduction of QB and RNA virus, 120–128
  synopsis, 137

Nonequilibrium phase transitions, homogeneous bifurcations and, 207–209
Nonequilibrium thermodynamics, chemical evolution and, 43–62
  dissipative structures, 46–54
  introduction, 43–46
  sensitivity and selection, 54–58
  stochastic aspects, 58–60
  summary, 60–61
Nonlinear energy converter, 159–166
Nucleosides, prebiotic synthesis, 103–105

Open-system, BZ reaction, 211–215
Optical activity, origin of, 109
Organic molecules and polymers, 85–107
  interstellar molecules, 100–101
  introduction, 85–89
    composition of primitive atmosphere, 89
    melting of primitive earth, 86–87
    oxygen, primitive atmosphere, 88–89
    temperature of primitive earth, 87–88
    time period, 86
  polymerization process, 101–105
    future work, 105
    nucleosides and polynucleotides, 103–105
    peptide synthesis, 101–103
  prebiotic synthesis, 89–101
    amino acids, 91–94
    carbonaceous chondrites, 99–100
    energy sources, 89–91
    mildly reducing and nonreducing atmospheres, 94–96
    purine and pyrimidine synthesis, 96–98
    sugars, 98–99
Oxidative phosphorylation, optimization, 141–167
  degree of coupling, 146–150
  introduction, 141–146
  nonlinear energy converter, 159–166
  thermodynamic buffering, 150–158
Oxygen, in primitive atmosphere, 88–89

Peptide synthesis, 101–103
Photosynthesis, prebiotic origin, 113–118
Pollution, atmosphere, 80–84
Polymerization processes, 101–105
  future work, 105
  nucleosides and polynucleotides, 103–105
  peptide synthesis, 101–103
Polymers, *see* Organic molecules and polymers
Polynucleotides, prebiotic synthesis, 103–105
Prebiotic synthesis, organic molecules and polymers, 85–107
  amino acids, 91–94
  in carbonaceous chondrites, 99–100
  energy sources, 89–91
  interstellar molecules, 100–101
  introduction, 85–89
  mildly reducing and nonreducing atmospheres, 94–96
  polymerization process, 101–105
  purine and pyrimidine, 96–98
  sugars, 98–99
Primary bifurcation, 178–179
Primitive atmosphere:
  composition of, 89
  oxygen in, 88–89

Primitive earth:
melting of, 86–87
temperature of, 87–88
Pure oxygen atmosphere, 64–67
Purine synthesis, 96–98
Pyrimidine synthesis, 96–98

Quasiharmonic and relaxation oscillations, transitions between (BZ reaction), 209–210

Regulation, biological systems, 248–252
continuous and discontinuous descriptions, 249–250
feedback loops, 250–252
homeostatic or epigenetic, 248
type of systems treated, 250

Secondary bifurcation, 180
Sensitivity and selection, nonequilibrium systems, 54–58
bifurcation diagram, 57
Singular perturbation, imperfection theory, 181–183
Solar radiation, absorption of, 64
Solvay Conferences:
in chemistry (1922–1978), 37–42
international cooperation, 1–5
in physics, 7–35
astrophysical problems, 27–30
introduction, 7–9
last constituents of matter, 9–23
solid-state and statistical mechanics, 23–27
Spatial correlation, principle of, 175
Spatiotemporal patterns, chirality and, 189–190
Stochastic aspects, nonequilibrium thermodynamics, 58–60
Stratospheric chemistry:
halogen compounds, 73–74
oxygen and nitrogen compounds, 72–73
Sugars, synthesis of, 98–99
Symmetry breaking, 186, 189

Temperature, primitive earth, 87–88
Thermodynamic buffering, 150–158
Time period, origin of life, 86
Time symmetry breaking, 187
Transdetermination and homeosis phenomena, 221–223
Trends, chemical evolution of atmosphere, 80
Trichlorofluoromethane, 76
Troposphere, hydrogen, nitrogen, and halogen compounds, 74–76

Variability, chemical evolution of atmosphere, 79–80